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**TITLE:**

Integrated Medical Information Technology System (IMITS):  
Information and Clinical Technologies for the Advancement of Healthcare

**PRINCIPAL INVESTIGATOR:**

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**CONTRACTING ORGANIZATION:**

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<b>13. Abstract (Maximum 200 Words) (abstract should contain no proprietary or confidential information)</b> UPMC and the United States Air Force Medical Service (AFMS) created a strategic partnership called the Integrated Medical Information Technology System Program (IMITS). IMITS focused on the implementation of advanced medical technology solutions that eliminate inefficiencies, increase utilization, and improve quality of care for active duty forces. Since the initiation of the program in late December 2002, UPMC and the AFMS successfully implemented several pilot telemedicine projects. Based on the success of the FY02 IMITS telemedicine programs, UPMC and the AFMS received additional congressional funding in FY04 and FY05 to continue advanced clinical and technology initiatives. These applications and processes were identified as areas of interest required to meet specific needs within the military and civilian health care delivery system. Each area was considered a sub-project of the overall proposal and was addressed individually from a research perspective.			
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## Introduction

The Integrated Medical Information Technology System (IMITS): Information and Clinical Technologies for the Advancement of Healthcare program focused on implementation of advanced technology solutions that eliminate inefficiencies, increase utilization, and improve quality of care for active duty forces. The work on this project covered the development and implementation of prototype telemedicine systems and advanced technology applications at United States Air Force (USAF) locations. Emphasis was placed on the development of sound evaluation methodologies for the sub-projects with special attention to areas of effectiveness and end-user satisfaction within the Air Force Medical Service (AFMS).

## Body

Since the initiation of the IMITS program in December 2002, UPMC and the AFMS successfully implemented several pilot telemedicine initiatives. FY02 IMITS selected areas of interest were regarded as sub-projects of the overall program and were addressed individually from a research and development perspective. Based on the success of the FY02 IMITS program, UPMC and the AFMS received additional congressional funding in FY04 and FY05 to continue to advance and expand their initiatives.

All IMITS research has been completed and, with the exception of FY05 IMITS: Distributed Radiology Dynamic Workload Allocation (DRDWA) project, final project reports were submitted to and approved by AF/SGRM. Table 1 provides FY02, 04, and 05 projects with final report submission dates to AF/SGRM.

This document covers remaining award reporting requirements followed by a full final report for the FY05 IMITS DRDWA project.

### ***History of Project Closures***

Table 1: FY02, 04, and 05 IMITS final project report submissions to AF/SGRM

<b>IMITS Project*</b>	<b>Final Report to AF/SGRM</b>
FY02 Emergency Medical Services	Mar 2005
FY02 Pediatric Tele-echocardiography	Jan 2006
FY02 and 04 Telepathology	Jul 2006
FY02 and 04 Teleradiology	Nov 2006
FY04 Simulation and Training: <i>Simulation at Wilford Hall Medical Center</i> <i>Patient Transfer Simulation Training</i>	May 2006 Apr 2007

<b>IMITS Project*</b>	<b>Final Report to AF/SGRM</b>
<i>Advanced Medical Education</i>	May 2007
FY04 Teleophthalmology	Jul 2007
FY04 Extra-Corporeal Membrane Oxygenation (ECMO)	Oct 2007
FY04 Teleaudiology	May 2008
FY04 Platelet Gel	May 2008
<b>FY 05 Telepathology</b>	<b>May 2009</b>

\*Copies of final reports are available upon request.

## **IMITS Award Supported Outcomes**

### **Patents and Licenses**

No patents or licenses were applied for or issued as part of the IMITS award.

### **Degrees Obtained**

Dr. Jonhan Ho received education/salary support while serving as a Pathology Informatics Fellow with the University of Pittsburgh. He became a board certified dermatopathologist with certifications in anatomic pathology, clinical pathology, and dermatopathology.

### **Development of Repositories**

- PathEd online repository of digital whole slide pathology images (<https://pathed.upmc.com>)

### **Informatics Databases**

- Distributed Radiology Dynamic Workload Association Application
- Static Image Application
- Ophthalmology Retinal Imaging Application
- PathEd Application

### **Funding Applications**

- Teleradiology/Enterprise Imaging
  - FY06: Continued development of a multi-disciplinary image archive
  - FY07: Distributed Radiology Dynamic Workflow Allocation
  - FY08: USAF Enterprise Imaging Inter-operability

- FY08: Teleradiology/ Enterprise Imaging Prototype Implementation – Enterprise Bus Architecture (EBA) and Dynamic Workload Allocation (DWA)
- FY09: Dynamic Workload Allocation (DWA) and Enterprise Imaging Exchange System
- FY10: Production Distributed Workflow Allocation Implementation/Certification
- Telepathology
  - FY05: Imaging in Telepathology
  - FY05: Virtual TelePathology Distance Education and Monitoring Initiative (VTDEM))  
FY05: Telepathology - Mississippi
  - FY08: Enhanced Diagnosis and Workflow Process using Digital Pathology
  - FY08: OpenDiamond: A Powerful Software Platform for Creating Content-Based Search Applications
  - FY08: IMITS Telepathology
  - FY09: Advancing the Practice of Digital Pathology within the AFMS: Regional Telepathology
  - FY10: Continuation: Advancing the Practice of Digital Pathology within the AFMS: Regional Telepathology
  - FY11: Continuation: Advancing the Practice of Digital Pathology within the AFMS: Regional Telepathology
- Teleaudiology
  - FY08: Remote access of cochlear implants Teleaudiology DIACAP / FDA certification
  - FY08: Teleaudiology DIACAP and FDA certification to conduct remote access, monitor, and adjust cochlear implants
- ECMO
  - FY05: Extra Corporeal Membrane Oxygenation (ECMO)
  - FY07 Pacific Rim ECMO/VAD
- Simulation and Training
  - FY05 DURIP: University of Pittsburgh Medical Center Medical Simulation Learning Environment Tool
  - FY05 DURIP: Virtual Reality Medical Training to support Head/Neck or Shock Trauma Educational Research
  - FY05: Nursing Simulation Training Initiative (NSTI)
  - FY06: Central Texas Medical Simulation Center of Excellence
  - FY07: WHMC Simulation Center
  - FY08: Gulf Coast Nursing Leadership and Simulation Training Center
  - FY09: Casualty Care Simulation Training (CCST) Center
- Platelet Gel
  - FY10 DMRDP: Improved Healing of Abdominal Trauma/Acute Surgical Wounds with AGP/AT

- FY10 BAA: Improved Healing of Abdominal Trauma and Acute Surgical Wounds with Autologous Platelet Gel Therapy Activated by Autologous Thrombin
- Teleophthalmology
  - FY05 DURIP: Virtual Reality Medical Training to support Ophthalmic Surgery Training and Research
  - FY08: Sub-Acute Ophthalmic Emergency Care
  - FY08: Virtual Reality Ophthalmic Surgery Training
  - FY09: Sub-Acute Ophthalmic Emergency Care
  - FY09: Spectral Optical Coherence Tomography (SOCT) for Laser Eye Injury
  - FY10 DMRDP: Spectral Optical Coherence Tomography (SOCT) for Laser Eye Injury
  - FY10 DMRDP: Sub-Acute Ophthalmic Emergency Care

## **Employment/Research Opportunities Based on Award Experience/Training**

- Telepathology and Teleradiology initiatives facilitated formation of Omnyx, a shared business initiative between UPMC and GE
- UPMC employment and consultation opportunities accepted by multiple Telepathology and Teleradiology staff
- Three new FTE positions created in UPMC Pathology Informatics for staff who began their work with UPMC through Telepathology
- UPMC pathology position accepted by pathology informatics student
- USAF intern for Telepathology offered position with Telehealth Branch of the AFMS/SGRM following her internship with IMITS and the Telepathology project
- Several administrative management staff promoted to lead positions within ISD at UPMC
- Teleradiology developer offered positions with other UPMC initiatives/departments following Stentor and DRDWA development

## **Personnel with Salary Support**

Table 2: List of Personnel with Salary Support from the award

Name	Title	PMO	TRAD	TPATH	CARD	EMS	AUD	ECMO	SIM	PG	OPH	EVAL
Bees, Jeffrey	Financial Advisor/Consultant		X									
Begg, Bryann	Administrative Coordinator			X								
Bell, Timothy	Staff Associate			X								
Campbell, Matt	Associate Director			X								
Carroll, Paige	Business Development			X								
Carter, Tera Y	Intern		X		X							
Celender, Patience	Administrative		X									

	Coordinator					
Gilstrap, Scott	Principal Investigator/VP	X				
Good, Janet	Project Mgmt Spec I	X				
Hardie, Bob	VP-Bu	X				
Houser, Jessica L	Intern	X				
Kamenar, Joseph M	Financial Analyst	X				
Krugh, Deanne	VP Operations	X				
Landman, Nancy	Dir. Tech. Bus. Dev.	X				
Love, Kim	Business Development	X				
McClelland, Sandra	Program Director	X				
Nicholls, Jeananne	Associate Director	X				
Panza, Rebecca	Administrative Coordinator	X				
Poole, Cathy	Clinical Systems Analyst III	X				
Turner, Tiffany	Financial Analyst	X				
Vollero, Jason	Business Development	X				
Yanuzo, Aaron	Program Director	X	X		X	X
Yates, Anthony	Clinical Advisor	X				
Amesur, Nikil M.D.	Domain Expert		X			
Avril, Norbert M.D.	Domain Expert		X			
Betancourt, Carlos	Software Architect		X			
Bowen, A'Delbert M.D.	Domain Expert		X			
Branstetter, Barton M.D.	Domain Expert		X			
Britton, Cynthia M.D.	Domain Expert		X			
Chang, Paul	Principal Investigator		X			X
Coast, Tom	Project Manager		X			
Crane, Ken	Programmer IV		X			
Dexter, Douglas	Programmer		X			
Ferris, James, M.D.	Domain Expert		X			
Grube, Audrey	Programmer IV		X			
Lionetti, Dave	Software Architect		X			
Momironski, Goran	Software Architect		X			
Moroney, Shawn	Programmer		X			
Oh, Kook Sang M.D.	Domain Expert		X			
Roberts, Jeffrey	Project Manager		X			
Rothfus, William M.D.	Domain Expert		X			
Sammon, John K. M.D.	Domain Expert		X			
Shah, Victor M.D.	Domain Expert		X			
Shrestha, Rasu	Principal Investigator		X			
Solomon, Edward M.D.	Domain Expert		X			
Thaete, F. Leland M.D.	Domain Expert		X			
Tublin, Mitchell	Domain Expert		X			
Wallace, Luisa M.D.	Domain Expert		X			
Warfel, Tom	Investigator		X			
Wilkins, Will	Programmer		X			
Anthony, Leslie	Project Manager		X	X		X
Henderson, Christine	IT consultation		X			X
Kistler, Michael	Project Manager		X			X
Yagi, Yukako	PI/Domain Expert		X			
Krills, Sandra	Researcher		X			X

Abdul-Kareem, Othman	Programmer IV	X		
Cecil, Roberta Ann	Programmer	X		
Danowski, Roni	Prjct Mngmnt Spec	X		
Drogowski, Laura	Researcher	X		
Duboy, John	PC Consultant I	X		
Gilbertson, John, M.D.	Principal Investigator	X		
Ho, Jonhan	Investigator	X		
Hoffman, Matthew	Web Developer	X		
Hrzic, Mark	Java Programmer	X		
Hudson, William	Senior Web Developer	X		
Jobe, Joyce	Sr. Help Desk Specialist	X		
Jukic, Drazen	Principal Investigator	X		
Kelly, Michael	Java Programmer	X		
Kepner, Joyce	Sr. QA Specialist	X		
Lawson, Alan	Chief Technical Officer	X		
Marraccini, Kevin	Application Support	X		
Nalesnik, Michael, M.D.	Domain Expert	X		
Petronik, Everett	Application Support	X		
Polatas, Holly	Training Specialist	X		
Roll, Marion	Project Manager	X		
Salava, Debra	Operations Manager	X		
Sharma, Anurag	Systems Analyst I	X		
Simko, Patricia	Certification Specialist	X		
Smith, Jeffrey	Data Security Specialist	X		
Teacher, Stephen	Sr. Database Developer	X		
Vaia, Patricia	Project Manager	X		
Wright, JoAnn	Sr. QA Specialist	X		
Yarzab, Richard	Senior Developer	X		
Handrahan, Jerry	Systems Analyst II	X		
Neches, William	Principal Investigator	X		
Delbridge, Ted	Principal Investigator		X	
Jarret, Patricia	Principal Investigator			
Roth, Claudia	Principal Investigator			
Palmer, Catherine MD	Principal Investigator		X	
Burgess, Lawrence MD	Principal Investigator		X	X
Caputo, Ralph	Domain Expert		X	
Berg, Benjamin	Domain Expert		X	
Bradle, Judy	Domain Expert		X	
Briggs-Foster, Cathy	Project Manager		X	
Dongilli, Tom	Domain Expert		X	
Garshnek, Victoria	Program Development		X	
Hara, Kris	Researcher		X	
Hudson, Don	Programmer		X	
John Schaefer	Principal Investigator		X	
Mechtel John	Project Manager		X	
Palumbo, Stephen	Project Manager		X	
Wolf, Gail	Principal Investigator		X	
Dave Steed MD	Principal Investigator		X	
Dyga, Robert	Domain Expert		X	
Thomas Serena MD	Principal Investigator		X	

Adams, Brian	IT consultation	X
Caywood, LouAnn	Project Manager	X
Eller, Andrew	Principal Investigator	X
Smail, John	Programmer	X
Uttecht, Steve	Programmer	X
Waller, Stephen MD	Principal Investigator	X
Ward, Jane	Project Manager	X
Warnicki, Joseph	Domain Expert	X
Barnes, Barbara	Principal Investigator	
Silowash, Russ	Programmer	
Chang, Joyce	Statitician	X
Friedman, Chuck	Principal Investigator	X
Gadd, Cynthia	Principal Investigator	X
Gatti, Guido	Statitician	X
Grzybicki, Dana	Principal Investigator	X
Porterfield, Toni	Researcher	X
Roberts, Mark	Principal Investigator	X
Wilson, Robb	Project Manager	X

## ***IMITS Award Conclusions***

IMITS activities focused on the implementation of medical technology solutions that increase efficiency and improve quality of care for active duty forces. Since the initiation of the program in late December 2002, UPMC and the AFMS successfully implemented several pilot telemedicine projects that serve to advanced AFMS clinical and technology resourcefulness. Project applications and processes were targeted by AFMS as essential to meeting specific needs within their military healthcare delivery system. Both the AFMS and UPMC benefited from the joint development and implementation of the multi-disciplinary IMITS initiatives and will continue to build upon the accomplishments.

For applications to serve their purpose, they must be available when needed. By and large, availability of IMITS applications has required rigorous, justified DoD security certifications followed by a complex and ever changing amalgamation of Air Force Communications Agency, Major Command and base-level approvals. The challenges innate to obtaining Air Force approvals have been further complicated by transient staffing, including leadership reassessments with subsequent shifts in awareness of and support for ongoing initiatives.

To realize the benefit of advanced technology applications, future initiatives must engage and maintain the support of military leadership, providing them with the knowledge needed to help all team members understand how their jobs relate to the goals of the project and to compel a shared commitment to its success.

# **FY05 IMITS: Distributed Radiology Dynamic Workload Allocation Final Project Report**

**AWARD NUMBER:** DAMD17-03-2-0017

**TITLE:**

IMITS: Distributed Radiology Dynamic Workload Allocation (DRDWA)

**CONTRACTING ORGANIZATION:**

UPMC  
600 Grant Street, 58<sup>th</sup> Floor  
Pittsburgh, PA 15219

**PERIOD OF PERFORMANCE:**

09/06/2006 – 08/31/2010

**REPORT DATE:**

08/31/2010

**PREPARED BY:**

Thomas Coast  
Goran Momiroski  
Shawn Moroney  
William Wilkins

**TYPE OF REPORT:**

Final IMITS DRDWA Project Report

## **DRDWA Introduction**

A symmetrical workload-balanced distributed radiology workflow prototype will support present and future radiology workload and workflow requirements across the AFMS as well as provide increased performance and scalability. Synchronous and asynchronous collaboration tools, as part of the developed symmetrical workflow model, will significantly improve radiologist productivity irrespective of geographical location.

## **DRDWA Body**

The FY05 IMITS DRDWA project was commissioned to develop a prototype solution for current Air Force Medical Services (AFMS) radiology workflow processing deficiencies. The Statement of Work (SOW) for the project is included here as Appendix 1. Phases I and II of the project were completed with summary reports submitted to AF/SGRM (Table 1 repeated below for reference). During Phases III – V of this project, it became apparent that the DRDWA prototype solution would have to be incorporated into a future enterprise imaging initiative, rather than continue as a stand-alone imaging solution.

Table 1: FY02, 04, and 05 IMITS final project report submissions to AF/SGRM

<b>IMITS Project*</b>	<b>Final Report to AF/SGRM</b>
FY02 Emergency Medical Services	Mar 2005
FY02 Pediatric Tele-echocardiography	Jan 2006
FY02 and 04 Telepathology	Jul 2006
FY02 and 04 Teleradiology	Nov 2006
FY04 Simulation and Training: <i>Simulation at Wilford Hall Medical Center</i> <i>Patient Transfer Simulation Training</i> <i>Advanced Medical Education</i>	May 2006 Apr 2007 May 2007
FY04 Teleophthalmology	Jul 2007
FY04 Extra-Corporeal Membrane Oxygenation (ECMO)	Oct 2007
FY04 Teleaudiology	May 2008
FY04 Platelet Gel	May 2008
FY 05 Telepathology	May 2009

\*Copies of final reports are available upon request.

Current AFMS staffing constraints, limited system capabilities, and a mobile physician and patient population require a sophisticated load-balanced distributed radiology/imaging workflow model and supporting infrastructure. These continually changing circumstances within the military healthcare community identified the need for a

sophisticated workflow model that supports an enterprise view. The DRDWA prototype solution aims to provide increased productivity and enhanced patient care across the AFMS regardless of physician staffing constraints, systems capabilities, and patient location. The infrastructure is capable of supporting a load-balanced distributed workflow model across multiple Major Commands (MAJCOMS) and within a multiple AFMS Picture Archiving Communication Systems (PACS) environment. The prototype solution allows for dynamic bi-directional transmission of clinical studies and optimal workflow load-balancing to effectively leverage resources irrespective of location, PACS vendor, or particular local workload demands. With a mobile patient population, this prototype provides relevant patient history to the radiologist/physician in order to render an accurate diagnosis. With regard to workload distribution, the prototype capabilities allow maximum workload flexibility during AFMS radiologist deployments, temporary duty (TDY), on-call support, and the development and availability of subspecialty expertise.

An AFMS-wide, sophisticated, load-balanced, and distributed radiology workflow model and supporting infrastructure will result in increased productivity, cost savings, and, above all, enhanced patient care across the AFMS regardless of medical staffing constraints or patient location. In addition, the prototype infrastructure could be the baseline architecture for enterprise imaging exchange throughout the AFMS regardless of medical discipline, and the intra/inter-base communication infrastructure for efficient clinical data exchange for all future AFMS healthcare information technology providers.

### ***DRDWA Phase I (Complete)***

The DRDWA project team conducted a six-month evaluation to identify the requirements and concerns of the AFMS radiology community. Findings and recommendations are contained within the DRDWA Phase I Report submitted to AF/SGRM on (available upon request).

During the evaluation phase, UPMC/UPMC IMITS Center project team ensured that a requirement for DRDWA/Enterprise Radiology existed. By engaging the appropriate AFMS partners, the IMITS project team was able to confirm the need for a distributed workflow solution and began to accurately define an acceptable DRDWA prototype. In order to accurately define a prototype solution, it was necessary for the project team to define business rule requirements in order to effectively determine how to traffic radiology images throughout the AFMS.

### ***DRDWA Phase II (Complete)***

The primary objective of Phase II was to develop and demonstrate the core supporting infrastructure (DRDWA). The development included the core concept design for the DRDWA system between two Air Force bases. Findings and recommendations are contained within the DRDWA Phase II Report (available upon request).

### **DRDWA Phase III**

The primary objective of Phase III was to finalize DRDWA development and demonstrate the final iteration of dynamic transfer of images between multiple Air Force bases. Development included the completion of the master command dashboard and local command interfaces. In addition, the DRDWA was designed to meet all clinical requirements set forth in Phase I of the project. Phase III objectives also involved developing referential interfacing requirements with existing military systems without performance degradation. The DRDWA development staff also created a combat trauma imaging simulator system to serve as a training repository for radiologists within the AFMS. In order to install and test on site with participating Air Force bases, the DRDWA had to initiate the Department of Defense Information Assurance Certification and Accreditation Process (DIACAP) process to obtain an Interim Authority to Test (IATT) certification. Phase III concluded with the hardware/software installation, testing, and final demonstration of the DRDWA between multiple Air Force bases.

The DRDWA Phase III objectives and outcomes are defined as follows:

- The UPMC IMITS project team created a master command dashboard and local command interface to control the functionality of the DRDWA. These dashboards were developed for use by appointed AFMS radiologists to monitor the flow and statistics of teleradiology. The dashboards are web based to provide ease of access from multiple Air Force locations. The dashboards are capable of compiling aggregate and historical statistics to assist radiology representatives in making strategic, enterprise wide decisions. The dashboard preferences include the ability to assess local reads, desired types of reads for each Air Force base, and rules for the export of radiological data. These dashboards represent the graphical user interface used in the ultimate control of the DRDWA.
- The IMITS project team established the clinical requirements for the operation of the DRDWA system. The DRDWA is able to dynamically allocated workflow among Air Force radiologists to maximize available manpower. The system is able to send images configured by radiology experts through the local command panel, while crediting interpreting radiologist for their work. This process remains transparent to the radiologists at all times, so that no priority is given to images according to the originating location. All DoD security guidelines and Health Insurance Portability and Accountability Act (HIPAA) standards have been maintained in the development of the DWDWA (DIACAP and security documentation is available for the DRDWA system). Patient care remains at the forefront of the DRDWA with the accurate and immediate transfer of diagnostic information.
- The IMITS project development team established the interfacing requirements of the DRDWA system with other AFMS initiatives. The Digital Imaging and Communications in Medicine (DICOM) standard interfaces allow communication between the DRDWA and various PACS vendors throughout the Air Force. This

DICOM standardization ensures interoperability with all existing DICOM capable imaging repositories and future additions to the Air Force medical imaging initiative. The Air Force maintains a high level standard in adhering to DICOM accepted practices and interfacing. The development team had no issues in communicating with the established PACS vendors utilized by the Air Force.

- The DRDWA software delivery includes a Combat Trauma Imaging Simulator. Primary functionality centered on the use of digital images, regardless of the source used to scan, and the organization of the images into easily searchable, useful categories. Secondary functionality was concerned with testing the physician's diagnostic ability; the tool was designed to support both administered and self-tests. As developed, the application boasts a constantly growing, customizable, digital image repository of history-enriched, common, interesting, and unique pathology cases that can be viewed and annotated by users who range in experience and level of training. User and case parameters can be channeled for targeted users and applications.

To meet the needs of the radiology community, the application can be used to create a repository of HIPAA-compliant combat trauma images for both reference and training purposes. AFMS radiologists lacking recent experience with trauma cases would have an accessible method to refresh and expand their education. This would provide a significant opportunity for those being deployed with little or no time available for specialized training. A robust repository of de-identified radiology images and patient data can further aid in the dissemination of knowledge across a variety of special interest areas. Radiologists can query cases or diagnoses of interest, conduct self-tests, and increase their knowledge of medicine based on their circumstances. Course instructors can use the application to supplement their training by choosing materials from the repository or by appending their own materials to the repository. Radiologists may be invited to join a group in which they are assigned specific cases and tests. Tests and user statistics can be made available to instructors for user and course analysis.

- The IMITS project team established a strategic partnership with the Integrated Clinical Database (ICDB) iDIS project. This project allowed the DRDWA to operate on security accredited servers and transport images on an established Enterprise Server Bus, iDIS. However, changes in ICDB command dissolved this collaborative effort in July 2009. The project team had to drastically modify its development plans to recreate the functionality that ICDB previously provided. The first and most challenging effect of this decision required the team to build independent servers to host the DRDWA services. The second issue required that the team create a network image transmission protocol to facilitate image sharing between existing PACS vendors. To complete testing and the subsequent demonstration, these independently developed solutions required DIACAP and IATT certification. The project team began the DIACAP certification process necessary to obtain an IATT certification. Once the IATT certification

was approved, the team installed local servers at the participating Air Force bases. The IATT for the DRDWA was granted on June 8, 2010 and remained effective until August 31, 2010.

- The implementation portion of the DRDWA project involved the installation of four servers on three Air Force bases, and the installation of all software services. A global server and a satellite server were installed at Wright-Patterson Air Force Base, Fairborn, OH. Satellite servers were installed at Dover Air Force Base, Dover, DE and MacDill Air Force Base, Tampa, FL. Each server was configured to communicate with the respective PACS on each Air Force base. Basic software and service installation was completed prior to shipping the servers to the Air Force bases. All the DRDWA servers were given IATT approval prior to base installation.
- After the servers were delivered to the assigned Air Force bases, the project team began an evaluation and testing period. All testing had to be completed in the assigned timeframe (June 8, 2010 to August 31, 2010). The IATT certification only allows for 2 hours of DRDWA testing on any weekday. During this evaluation period, several configuration and benchmarking stages needed to occur to enable a complete demonstration. Remote connectivity to each server had to be established through the DoD approved software, DCO Connect. Once remote connectivity was established, the IMITs development team could control each server from the UPMC offices and begin the configuration process. Local configuration from each DRDWA server to its corresponding PACS server was completed with no significant issues.

Connectivity between the DRDWA satellite servers on separate bases was problematic at times. The connection between Dover AFB and Wright-Patterson AFB was established without issues. However, the connection between MacDill AFB and Wright-Patterson AFB showed dropped information packets and other general delays. Subsequent testing revealed that the MacDill AFB network had increased latency when compared with the other bases: information was slow to traverse the network, and often packets of image data were lost during transmission to the final destination. Regardless of these testing issues, IMITs and the Air Force decided to proceed with the demonstration scheduled August 27, 2010.

- A live demonstration with the three participating Air Force bases was performed on August 27, 2010 at Wright-Patterson AFB. This demonstration was used as a prototype benchmark; highlighting the developmental efforts undertaken by the IMITs team throughout the DRDWA project. The three sites, Wright-Patterson AFB (Fuji), Dover AFB (Agfa), and MacDill AFB (AGFA), allowed three separate PACS to be represented. Remote viewing was available for participants who were unable to attend the presentation at Wright-Patterson AFB. The DRDWA project team and participants from the Air Force were aware that network issues at MacDill AFB could prevent successful image transfer to the Wright-Patterson

DRDWA servers. However, these network issues were nonexistent during the final demonstration, and images were transferred between all participating bases.

- The final deliverable for the DRDWA project included system and user documentation for the DRDWA infrastructure. This documentation will assist with future efforts to implement the DRDWA if needed. This documentation will also include training manuals for the basic operation of the DRDWA services and policies. At the conclusion of the project, all DRDWA software code and purchased hardware were delivered to the Office of the Air Force Surgeon General in a format deemed appropriate for future consideration.

#### ***DRDWA Phase IV***

The IMITS project team identified several areas within the DRDWA for enhancement/improvement. The following key functionality additions were recognized through the course of the project: Resource Scheduling Module, Graphical User Interface (GUI) enhancements, 3D/4D Image Post-Processing, Dictation and Transcription Integration, and Image Compression (Hardware/Software). Several companies have been identified for potential partnerships within these improvement areas. The Phase IV objectives were interrupted due to the removal of ICDB/iDIS, however, a brief investigation was still conducted into several areas of improvement.

The FY05 – DRDWA Phase IV objectives and outcomes are defined as follows:

- The research and evaluation of a Resource Scheduling module was the first initiative in Phase IV. Resource scheduling for available AFMS radiologists and staff would greatly improve the capabilities of the master and local command panels. DRDWA routing algorithms would benefit immensely by having each radiologists schedule programmed into the system. This availability, matched with modality and sub-specialty information, would allow the DRDWA system to automatically route exams more accurately. Numerous Radiology Information Systems (RIS) currently utilize this scheduling capacity to enhance patient care and maximize exam resources. The DRDWA development team completed a scheduling module that is included in the final code delivery.
- The IMITS project team worked to identify potential technology partnerships for module and GUI enhancements. By adding partnerships with imaging specialty companies the DRDWA would provide a more comprehensive imaging management system. UPMC Radiology Informatics developed Single View to connect the RIS and PACS across multiple UPMC hospitals in the greater Pittsburgh, PA area. By utilizing a single work list, an efficient web-based client can access patient data in one consistent format. Sub-specialization focus delivers information to appropriate physician, in real time regardless of location, which allows full leveraging of physician subspecialty and expertise. Connecting multiple RIS and PACS solutions through one information bus optimizes existing systems by connecting all sources that store and display imaging studies and

associated patient information. Immediate access to patient data across multiple systems provides the ability to read studies faster, thereby increasing radiology process throughput.

- The investigation for 3D/4D Image Post-Processing was initiated after viewing several presentations at the Radiological Society of North America (RSNA) conference 2008. Healthcare equipment vendors have been seeking to provide an integrated diagnostic model facilitating patient-centric, evidence-based healthcare. The major features of post-processing include workflow tasks such as image processing, image reconstruction, computer-aided detection, three-dimensional (3D) view generation, and quality control. Innovations in radiological diagnostic imaging step into the next generation of technology, offering 3D/4D imaging views of the diagnostic images taken from standard equipment.
- The DRDWA should be integrated with current dictation and transcription solutions to provide a more robust platform for radiologists. Dictation and transcription are core modules within radiology overall workflow. Integration with these modules would provide a higher level of data management within the DRDWA. However, the USAF iterations of dictation and transcription have a wider range than current PACS implementations. This widespread array of applications creates a project on a much larger scale than even the DRDWA. Under the current and foreseeable scope of the DRDWA, dictation and transcription integration was just not a feasible option.
- Hardware and Software Image compression is a constant concern for enterprise imaging solutions where network bandwidth is limited. The development of PACS and the increasing use of large digital sets from various imaging modalities present challenges in image management, distribution, storage and interpretation. Teleradiology enables remote interpretation but is encumbered by bandwidth restrictions. Image compression is a means by which Teleradiology access may be improved, and storage costs reduced. Currently, all digital image interpretation, transmission and storage practiced within the DoD facilities are done without irreversible data loss. This limits transmission and storage to lossless compression technology with 2:1 being the most typical compression ratio in any given PACS environment. The result is long transmission times for large data sets and high image storage costs. This will only get worse with increasingly large data sets and additional demand for image resources.

## **DRDWA Phase V**

The IMITS project team intended to use Phase V of the project for additional development based on the Phase IV enhancements/improvement. This phase, however, was contingent on having remaining funds in the DRDWA project. When the ICDB iDIS solution was removed from the project, remaining funds had to be diverted to create a core DRDWA infrastructure. This new infrastructure included the purchase of four server class computers, and the development of an image transmission protocol for use on the AFMS network. The IMITS project team was successful in replacing the

basic functionality initially provided by ICDB iDIS, but the time and funding required for this endeavor effectively eliminated the possibility of Phase V development.

### ***DRDWA Barriers to Completion***

During the development and testing of the DRDWA prototype solution, numerous barriers to completion were noted by members of the project team in order to increase efficiency in future solutions for the AFMS. The continuing evaluation of existing AFMS protocols will allow for more effective project planning, should future projects be considered for AFMS integration. The IMITS project team identified three areas illustrating the barriers to completion for the DRDWA.

- The IMITS project team established a strategic partnership with ICDB iDIS project within the Air Force infrastructure. This partnership allowed IMITS project team to drastically reduce costs and developmental efforts. This collaborative effort with ICDB provided the DRDWA project with a proven network backbone for data transmission within the Air Force for image acquisition, transfer, and data sharing. ICDB iDIS effectively eliminated the need for remote point-to-point services in the DRDWA between individual Air Force bases. Not only did this reduce costs in the network structure schema, but it also diminishes the need for independent certification for each additional base.

In July 2009, the ICDB Program Management Office (PMO) decided to no longer support any DRDWA initiatives. This vast change to the project scope was due changing leadership within the PMO and staff changes. The IMITS project team engaged the new ICDB management in an attempt to resolve project sustainability issues; however, ICDB no longer had the manpower or interest to support the DRDWA project. This single decision caused a series of events that delayed the project at least eighteen months.

- DIACAP and IATT certification processes were required complete the DRDWA Phase III deliverables. Standard DIACAP procedures can take up to 18 months for complete system certification, hardware and software. The documentation and compulsory specifications for the DRDWA DIACAP took approximately 6 months to complete. After the initial artifacts were complete, the IMITS project team could then begin actual testing with the Information Assurance (IA) department. The IA live testing requirements used another 6 months to complete. Once all the documentation and test results were reviewed by IA, another month was required to award the IATT for an effective 90 days. The IA process is an laborious effort that future projects must be aware of when assigning project timeframes and deliverables.
- The Composite Health Care System (CHCS) is a medical informatics system designed by Science Applications International Corporation (SAIC) and used by all United States military health care centers. A core component to successful

production operation of the DRDWA is CHCS interfacing. The IMITS project team was never able to locate a champion for bi-directional interfacing with CHCS. The DRDWA was never able to properly integrate these bi-directional interfaces in the core functionality. Orders placed in the CHCS system serve as triggers for the initiation of DRDWA servers, eliminating the need for manual interaction with the system. SAIC provides neither testing facilities nor adequate interface specifications to simplify a prototype or development initiative. Future projects requiring CHCS integration must properly engage SAIC to encourage expanded interfacing capabilities.

## ***DRDWA Key Accomplishments***

- Analyzed and documented the MTFs existing Information Systems and infrastructure to determine the feasibility of a DRDWA solution.
- Defined business rules requirements to determine the traffic of images.
- Provided an Initial Concept Design Document to SGR, outlining network traffic requirements, security requirements, and limitations of a new load balancing system.
- Provided DRDWA Phase I report/initial concept documents to AF/SGRM.
- Completed development of the core DRDWA components for select AFMS MTFs:
  - DICOM Concentrator
  - PACS Web Services
  - RAD Web Services
- Established a strategic partnership with the ICDB PMO and the iDIS initiative.
- Completed a functional demonstration (June 12, 2008) of core components between Wright-Patterson and Dover Air Force Bases.
- Provided DRDWA Phase II report documents to AF/SGRM.
- Completed a local DRDWA demonstration (March 11, 2009) for AF/SGRM.
- Identified five additional areas for improvement within the DRDWA solution.
- Developed the DRDWA image transport mechanism to replace the ICDB/iDIS solution.
- Began the DoD DIACAP process, and received an IATT certification for 90 days of testing prior to a final demonstration.
- Installed 4 DRDWA servers on Wright-Patterson, Dover, and MacDill Air Force Bases.
- Established remote connectivity to the DRDWA servers located at Wright-Patterson, Dover, and MacDill Air Force Bases.
- Completed a full demonstration (August 27, 2010) of the final DRDWA solution between Wright-Patterson, Dover, and MacDill Air Force Bases.
- Provided DRDWA Phase III-V report documents to AF/SGRM.
- Delivered Final DRDWA solution code and instruction documentation to AF/SGRM.

## ***DRDWA Reportable Outcomes***

## **Abstracts and Presentations**

- Rasu B. Shrestha, MD, MBA; Aaron C. Yanuzo, BS, MBA; Carlos Betancourt, BS; Goran Momiroski, BS, MS; Thomas H. Coast, BS; Shawn Moroney, BS; James Mason, BS; Steve Livingston (4/2009). *IMITS Program Overview with Implementation of Dynamic Workload Allocation within the Air Force Medical Service*. 2008 American Telemedicine Association Annual Conference, Seattle, WA
- Rasu B. Shrestha, MD, MBA; Aaron C. Yanuzo, BS, MBA; Carlos Betancourt, BS; Goran Momiroski, BS, MS; Thomas H. Coast, BS; Shawn Moroney, BS; James Mason, BS; Steve Livingston (4/2008). *Programming - Dynamic Workload Allocation Routing Engine and Intelligent Algorithms*. 2008 American Telemedicine Association Annual Conference, Seattle, WA
- Russell Silowash, Robert A Wilson, Dana Grzybicki, MD, PhD. (4/2008). *Evaluation – Distributed Radiology Dynamic Workload Association System for AFMS*. 2008 American Telemedicine Association Annual Conference, Seattle, WA

## **DRDWA Conclusions**

The FY05 congressional research project: IMITS DRDWA evaluated the utility of a load-balanced distributed radiology/imaging dynamic workload allocation infrastructure. The DRDWA project was divided into five phases. Phase I and II focused on investigation of requirements and design. Phase III completion demonstrated success in connecting and transmitting images and data between different PACS within the AFMS. The entire IMITS project team – consisting of several members of UPMC, UPMC IMITS Center (DoD Program Management Office), the SGR Congressional project manager, and with input from the AF Radiology Consultant, completed the prototype demonstration, and provided recommendations for future integration with enterprise imaging solutions with the AFMS. After the Phase III demonstration, the AFMS PACS office expressed direct interest in implementing the DRDWA to production as soon as possible.

The DRDWA prototype promises to increase productivity, cost savings, and above all enhanced patient care regardless of physician staffing constraints or patient location. The proposed solution and infrastructure support a symmetrical load-balanced distributed workflow model across MAJCOMS and in multiple PACS environments. The prototype solution allows dynamic bi-directional transmission of clinical studies and optimal workflow load-balancing to effectively leverage resources irrespective of location, PACS vendor or particular local workload demands. This prototype solution also provides to the physician relevant patient history required for an accurate diagnosis in a continually moving patient population throughout the AFMS. The proposed infrastructure can be incorporated with the baseline architecture for enterprise imaging

exchange through the AFMS. This will allow for more flexibility with regards to workload distribution during AFMS radiologist deployments, TDY, on-call support and the development and availability of subspecialty expertise.

In conducting the FY05 IMITS DRDWA project, the IMITS project team became aware of a strong level of interest by the AFMS PACS office. The PACS administration team expressed a strong need for immediate investigation into a multiple site DRDWA implementation. This type of implementation would require several steps to complete. Full bi-directional interfacing with CHCS must be achieved to realize the intended automation of the DRDWA services. The DRDWA would also have to complete the entire DIACAP process to become a production enabled system. At the conclusion of the project, the DRDWA services and hardware had only been granted an IATT approval. Additional IA processes would have to be finalized to certify the DRDWA as an Air Force approved application. A certification and implementation, even on a small scale, would require an approximate minimum of 18 months to accomplish.

In contrast to installing the DRDWA as a stand-alone solution in the AFMS, the DRDWA code can be used to assist development of alternate enterprise imaging initiatives. The DRDWA infrastructure can serve as the baseline framework for inter-operability architecture for future Military Health Service (MHS) Telehealth initiatives as well as the baseline for all enterprise imaging exchange throughout the MHS regardless of medical discipline. The expansion of this project could be the initial integration of the DRDWA with additional digital imaging formats as well as other multimedia medical record files. This will initiate the expansion of the prototype solution throughout the MHS. Production acceptance integration could effectively cover several MHS Medical Centers, and potentially the Veteran's Health Services. UPMC provided the foundation for digital imaging inter-operability to the AFMS by creating an integration platform that would allow communication and transportation of data from site to site. Continual enhancements to the DRDWA prototype solution will provide the mechanism for other digital images such as: pathology, cardiology, and ophthalmology to be transported from one Medical Treatment Facility (MTF) within the AFMS or MHS to another for either or both diagnostic or referential usage by a physician.

This report is the final project report/deliverable for the FY05 Congressional project: IMITS DRDWA (Cooperative Agreement DAMD1703-2-0017).

## ***DRDWA References***

### **Acronyms**

3D Three	Dimensional
4D Four	Dimensional
AFB	Air Force Base
AFMS	Air Force Medical Services

CHCS	Composite Health Care System
DIACAP	Department of Defense Information Assurance Certification and Accreditation Process
DICOM	Digital Imaging and Communications in Medicine
DoD	Department of Defense
DRDWA	Distributed Radiology Dynamic Workload Allocation
GUI	Graphical User Interface
HIPAA	Health Insurance Portability and Accountability Act
IATT	Interim Authority To Test
ICDB Integrated	Clinical Database
iDIS	Intelligent Data Integration Service
IMITs	Innovative Medical Information Technology Systems
MAJCOMS	Major Commands
MTF	Medical Treatment Facility
MHS	Military Health Services
PACS Picture	Archiving Communication System
RIS Radiology	Information System
RSNA	Radiology Society of North America
SOW Statement	of Work
TDY Temporary	Duty

## **DRDWA Appendices**

### **Appendix 1: DRDWA Statement of Work**

#### **Develop and implement a Distributed Radiology Dynamic Workload Allocation Infrastructure Prototype at select Air Force Medical Treatment Facilities (MTF).**

**Phase 1 - Analyze and document select MTFs existing Information Systems and Infrastructure to determine Distributed Radiology Dynamic Workload Allocation Systems Feasibility: (7 Months)**

**USAF Principal Investigator:** Col. Grant Tibbets  
**UPMC Principal Investigator:** Dr. Rasu B. Shrestha  
**Timeframe:** October 2006 – May 2007  
**Completed:** May 2007

<b>Timeframe</b>	<b>Task</b>
Weeks 1-12	Assess Base, MAJCOM and Headquarters level staff for participation and support of proposed project.
Weeks 1-12	Establish a baseline of information systems, technology and infrastructure at participating MTFs. Document current systems' distribution and capture capabilities
Weeks 1-16	Assess information assurance and workload crediting policy and procedures. Discuss and coordinate with Information Assurance departments at Base, MAJCOM and Headquarters level to obtain information and input. Assessment of DoD system security policies and procedures (i.e. IATO, ICTO, CoN, DIACAP). Document and obtain policy and approval for bidirectional interface to participating MTFs local systems (i.e. Composite Health Care Systems/II (CHCS/CHCSII/AHLTA)). Coordinate and discuss project at each level.
Weeks 12-24	Define business rules requirements to determine traffic of images. Ensure that documented business rules incorporate radiologist, availability, desired study type, historical site performance and professional currency requirements to determine traffic of images. Investigate and document healthcare workload policies and procedures between sites within a distributed environment. E.g Relative Value Unit (RVUs) allocation between sites/providers performing the work. Capture existing practice processes and rules relating to radiology.
Weeks 12-24	Assess, document and measure existing diagnostic imaging system performance (e.g image transmission requirements, repository/central cache requirements...)

Timeframe	Task
Weeks 20-24	Provide SGR with a report which will serve as an Initial Concept Document (ICD). The ICD will include network requirements (bandwidth availability, saturation point/base), business rules (expected turnaround time), and MAJCOM Security Requirements. ICD will support a concept decision regarding USAF and/or DoD limitations that may alter the outcome/deliverables of the research project.

**Phase 2 - Develop Distributed Radiology Dynamic Workload Allocation System prototype for select USAF MTFs (12 Months) (Phase 2 to begin upon completion, by SGR, of NDAA Certification):**

**Timeframe:** **May 2007 – May 2008**

**Completed:** **May 2008**

Timeframe	Task
Weeks 24-72	Establish system administrator privileges. 1) Create a web-based system command panel to monitor system maintenance events. 2) Incorporate common issues found during testing into the maintenance panel.
Weeks 24-72	Establish a workload accounting process in system: Workload crediting available by site of acquisition (technical component). Workload crediting available by site of interpretation (professional component). System accurately credits the correct number of relative value units. Coordinate with Composite Health Care System (CHCS) and radiology personnel at each base to determine acceptable methods for adding shared work credit Relative Value Unit (RVU)/Current Procedure Terminology (CPT) codes to the Composite Health Care System (CHCS). System will auto register patients into the remote Composite Health Care System (CHCS) system.
Weeks 24-72	Create a central repository storage and system infrastructure
Weeks 24-72	Create a central image routing engine that includes the following features: The image routing engine will contain the necessary algorithms to efficiently route images. Algorithms may be adjusted from the Master Control Panel. The image routing engine will use radiologist availability, desired study type, and historical site performance to determine quantity and type of images to forward. The image routing engine will follow a 'round robin' pattern in distribution.

Timeframe	Task
	<p>The image routing engine will have safeguards so that it does not overwhelm a site.</p> <p>The image routing engine will have logic to retransmit images to an alternate location if a remote site is unexpectedly not conducting reads.</p> <p>Final read location for failed reads will be Wilford Hall Medical Center radiology department.</p>
Weeks 24-72	<p>Establish imaging and image transmission technical processes:</p> <p>Ensure ability to utilize network compression for transmission purposes without data loss (lossless or clinical compression).</p> <p>Ensure ability to present current images along with all relevant prior images and reports from acquisition site is provided.</p> <p>Ensure exams are identified by site of original acquisition for command and control purposes.</p> <p>Create notification of study availability via local Picture Archive and Communication System (PACS) work list, independent of site of image acquisition.</p> <p>Image delivery will be transparent to the radiologist.</p> <p>6) System will meet Air Force firewall requirements.</p> <p>7) Establish bidirectional communication through Virtual Private Network to sites.</p>
Weeks 24-72	<p>Ensure system meets all integration requirements:</p> <p>Product shall have a Digital Imaging and Communications in Medicine (DICOM) transmitter available for local integration with other applications.</p> <p>Compose and submit to SGR a thorough document detailing the minimum Input/Output (I/O) &amp; processing capabilities of any local stores to prevent queuing when the pilot is scaled up to the enterprise.</p>
Weeks 24-72	<p>Build a DICOM transmitter to relay images to secondary source:</p> <p>The transmitter will have the option to be turned off and will be deployed in the 'off' setting.</p> <p>3) Before deploying the product, the transmitter will be tested in a developmental environment to gauge theoretical throughput. This will assist personnel interfacing with the system in knowing what throughput could be expected.</p> <p>Complete and review all Phase 2 development.</p> <p>Complete the Functional Demonstration between Wright-Patterson and Dover.</p> <p>6) Submit the Phase 2 Report to SGR.</p>

**Phase 3 - Complete GUI Development and Implement a USAF and DoD accredited Distributed Radiology Dynamic Workload Allocation System prototype at select MTFs: (6 Months)**

**Timeframe:** **June 2008 – August 2010**  
**Completed:** **August 2010**

<b>Timeframe</b>	<b>Task</b>
Weeks 72-96	<p>Create a master command dashboard and local command interface</p> <p>The dashboard will be available for the appointed Air Force Radiologist to monitor the flow and statistics of teleradiology.</p> <p>This command window will produce aggregate statistics of image reads and transfers.</p> <p>Master Command Dashboard will be web-based.</p> <p>Dashboard will compile aggregate and historical statistics to aid the SG Radiology representative in making strategic, enterprise radiology decisions.</p> <p>The local command interface will be available to the local system administration designee to indicate site preferences.</p> <p>These preferences will include, but are not limited to, availability to perform reads, desired type of reads and rules for export of data.</p> <p>Local Command Interface will be web-based.</p>
Weeks 72-96	<p>Ensure system meets all prescribed clinical requirements:</p> <p>The system must dynamically allocate workflow among Air Force Radiologists such that a balance workload exists that maximizes available manpower.</p> <p>The system must be able to send differentiated types of images configured by Radiology representative through the local command panel.</p> <p>The system must reliably credit Radiologists for their work.</p> <p>The system must seamlessly display local and remote images in the same manner so that no prejudice or priority is given to different locations.</p> <p>The system shall conform to all AF &amp; DoD Security guidelines, HIPAA standards. Best practices for disaster recovery will be documented for an enterprise deployment.</p> <p>The system must be able to deliver images in an expeditious manner such that patient care standards and read times are maintained.</p> <p>Structure of system must allow for it to be the technical substrate for other DICOM format Telehealth initiatives (ophthalmology, pathology, etc.).</p>
Weeks 72-96	<p>Determine referential system interfacing requirements:</p> <p>Create a document that outlines the ideal requirements of a referential imaging system that could interface with the Diagnostic Imaging System without performance degradation.</p> <p>Indicate the robustness of hardware required on the Diagnostic Imaging side to support a secondary Referential Imaging system.</p> <p>Create and submit to SGR a detailed disclaimer outlining the negative effects on the primary Diagnostic Imaging System if proper interfacing guidelines are not followed.</p>

Timeframe	Task
Weeks 72-96	Create a Combat Trauma Imaging Simulator: System will store HIPAA-compliant, combat radiology images for training purposes. Images will be available to read for training purposes. Practice interpretations will be contrasted against actual archived reads.
Weeks 96-136	Obtain necessary MAJCOM interim approvals to operate for length of Distributed Radiology Dynamic Workload Allocation research project. Originally placed in Phase VI
Weeks 96-136	Implementation: Install Distributed Radiology Dynamic Workload Allocation infrastructure at central location and select MTFs.
Weeks 96-136	Evaluation: Test installed Distributed Radiology Dynamic Workload Allocation at central location and select MTFs.
Weeks 96-136	Documentation: Finalize System and User documentation for Distributed Radiology Dynamic Workload Allocation infrastructure.
Weeks 96-136	Training: Train all users at select MTFs and central location. Provide training documentation and summary report to SGR.
Weeks 96-136	Go-Live and provide Distributed Radiology Dynamic Workload Allocation demonstration to USAF, including SGR.
	Turn over Distributed Radiology Dynamic Workload Allocation hardware and UPMC/UPMC IMITs Center project team developed Distributed Radiology Dynamic Workload Allocation software to USAF for support. Submit Phase III-V report to SGR. NOTE: If Air Force approves Distributed Radiology Dynamic Workload Allocation project, full DIACAP certification will be required to replace timed approval to operate from participating MAJCOMs.

**Phase 4 - Investigation for additional functionality in the Distributed Radiology Dynamic Workload Allocation System prototype: (4 Months)**

**Timeframe:** December 2008 – August 2010

**Completed:** August 2010

Timeframe	Task
Weeks 96-112	Identify potential areas within the DRDWA prototype model for enhancement. Research an additional Resource Scheduling module. Identify potential vendor partnerships for module enhancements. 3D/4D Image Post-Processing Investigate program integration for Dictation and Transcription functionality. Image compression (Hardware / Software)
Weeks 96-112	Conduct thorough investigation on all identified improvement modules. Conduct research to identify best suited vendors for additional modules. Develop feasibility categories for each vendor and module.

Timeframe	Task
Weeks 96-112	Develop a feasibility study report based on Phase 4 finding for SGR. Document a plan for modification additions to be developed in Phase 5.

**Phase 5 - Development on accepted functional additions to the Distributed Radiology**

**Dynamic Workload Allocation System: (6 Months)**

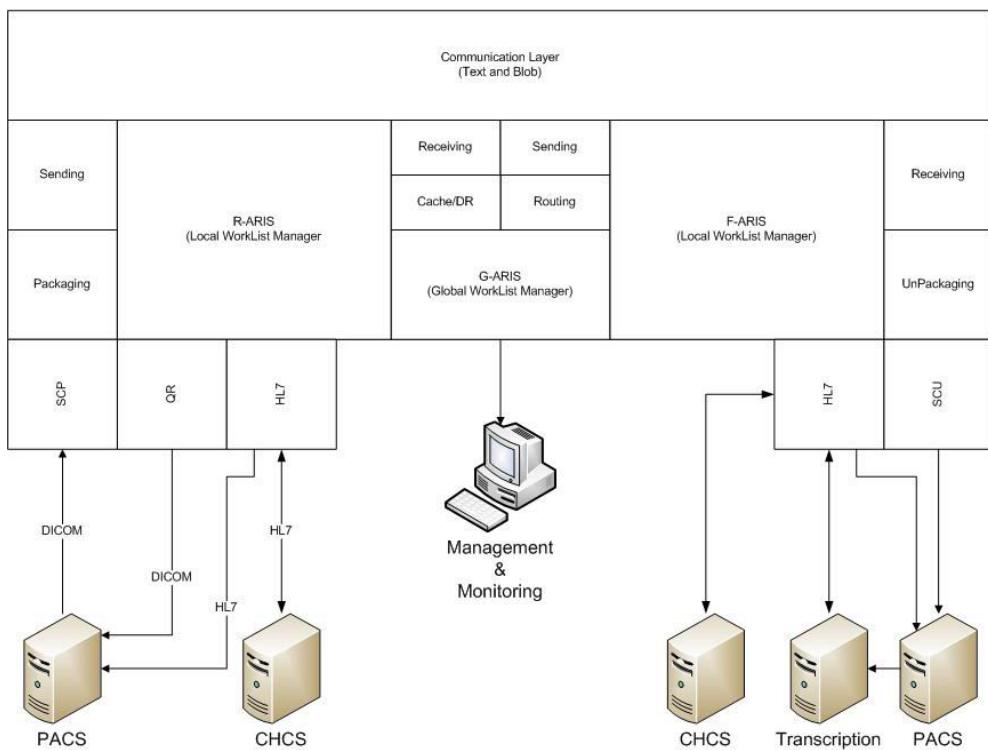
**Timeframe:** **April 2009 – August 2010**

**Completed:** **August 2010**

Timeframe	Task
Weeks 112-136	Begin new development cycle based on 3 to 5 areas of additional functionality for the DRDWA. Test new development modules in the original DRDWA code base. Install new functional modules at prototype MTFs for testing.
Weeks 112-136	Demonstrate all new modules at prototype MTFs for SGR. Provide summary report to SGR on additional functionality demonstration.

## Appendix 2: DRDWA Diagram

### IMITS/AFMS Partner Collaboration



## **Appendix 3: 2008 ATA Abstract and Presentation: IMITS and DWA within the AFMS**

1 Rasu B. Shrestha, MD, MBA, 2 Aaron C. Yanuzo, BS, MBA, 1 Carlos Betancourt, BS, 2 Goran Momiroski, BS, MS, 1 Thomas H. Coast, BS, 1 Shawn Moroney, BS, 1 James Mason, BS, 3 Steve Livingston, BS 4

*1UPMC - Innovative Medical and Information Technologies Center (IMITS), Pittsburgh, PA; 2UPMC, Pittsburgh, PA;; 3USAF - Wilford Hall Medical Center, San Antonio, TX; 4SAIC - ICDB, San Antonio, TX*

Air Force Medical Service (AFMS) and Military Health Service (MHS) have initiated several programs to address improvements in health care through information technology. One of these initiatives commissioned UPMC Innovative Medical and Information Technology (IMITS) Center to develop a prototype solution for Radiology Dynamic Workload Allocation (DWA) addressing radiology workflow deficiencies. It has become evident that the DWA prototype solution should also include enterprise clinical imaging workflow efficiency capabilities beyond radiology. Current AFMS staffing constraints, limited system capabilities, and a mobile patient population requires a sophisticated load-balanced distributed imaging workflow model and supporting infrastructure. These continually changing circumstances within the military healthcare community have identify the need for a sophisticated workflow model that supports an enterprise view. The prototype solution will result in increased productivity and enhanced patient care across the AFMS regardless of physician staffing constraints, systems capabilities and patient location. The infrastructure will support a load-balanced distributed workflow model across multiple Major Commands (MAJCOMS) and within a multiple Picture Archiving Communication Systems (PACS) environment. The prototype solution will allow dynamic bi-directional transmission of clinical studies and optimal workflow load-balancing to effectively leverage resources irrespective of location, PACS, or particular local workload demands. The DWA algorithmically distributes radiology cases throughout AFMS equally depending on radiologist availability, modality type, and location. Within a mobile patient population, this prototype solution will provide relevant patient history, to the radiologist, enabling an accurate diagnosis. With regard to workload distribution; these capabilities will allow maximum workload flexibility during radiologist deployments, TDY, on-call support, and the development and availability of subspecialty expertise. When the DWA proves to be an effective workload allocation tool, not only will patient care improve throughout the AFMS, but radiologists will be able to strengthen their practice by increasing their knowledge in subspecialty experiences.

**IMITS**  
Program Review  
ATA 2008

**UPMC**  
IMITS Center

**UPMC Overview**

- Integrated Healthcare System consisting of 20 hospitals
- Invested in development of leading healthcare technology
- Strategic Business Unit / Initiative
  - Dedicated to the commercialization of healthcare technology and telehealth initiatives
- Interoperability
  - Creates an infrastructure for vendor neutral environment
  - Allows for centralized data / image acquisition

**UPMC**  
IMITS Center Overview

- UPMC Innovative Medical and Information Technologies (IMITS) Center
- 2001 – IMITS Program USAF Telehealth Initiative
- 2004 – DoD Program Management Office (PMO)
  - Continued funding for IMITS Program
- 2007 – IMITS Center
  - Incorporated as Wholly Owned Non-Profit Subsidiary
  - Added Flexibility to Develop Robust Government Sales/Services Division
  - Provides
    - Continual growth and funding, establishes new research programs
    - Researcher and Physician Leaders/Advisors
    - Program and Process Management / PMP / Accounting and Finance Expertise
    - Experience in Government Contracts, Government Contracts, Software Development, Systems and Network Architecture, Industrial Engineering, Private Academics and Non-Profit sectors, Healthcare, medical products, and Military (Whitaker and others)

**UPMC**  
IMITS Center

**IMITS Program Overview**  
Telehealth, Simulation, & Education

**FY02 IMITS – All Projects Are Complete**

• Teleradiology	• Pediatric Tele-Echo
• Telepathology	• Evaluation

**FY04 IMITS**

• Teleradiology	• Pediatric Tele-Echo	• Simulation
• Telepathology	• EDMD	• Naval
• Teleophthalmology	• Evaluation	• Nursing
• Telesurgery		• WHMC

**FY06 IMITS**

• Telepathology	• Teleradiology
• Evaluation	• Evaluation

**UPMC**  
IMITS Center  
www.upmcimitscenter.com

**IMITS FY02 / FY04**

**Date/Funding:** 10/01/02 – 12/31/07

**Program Director:**  
IMITS – Aaron Yanuzzo

**Project Manager:**  
Teleradiology – Tom Coast  
Telepathology / Teleophthalmology / ECMO – Leslie Anthony  
Telesaudiology / Simulation / Platelet Gel / Evaluation – Aaron Yanuzzo

**UPMC / AFMS – Purpose / Focus:**

- Implementation / evaluation of clinical telemedicine systems / applications
- Identification of new technical and clinical initiatives key areas for development

**Objectives:**

- Evaluate the utility of advanced clinical technology / applications as an alternate means of healthcare delivery
- Provide AFMS with strong rationale for the adoption of these technologies

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**FY02 Accomplishments (WPAFB):**  
Customized, Deployed, and Supported UPMC patented Dynamic Transfer of Syntax (DTS) technology

**FY04 Accomplishments (WPAFB):**

- AFMS Enterprise contribution not MTF-to-MTF solution
- Build on BGR/UPMC positive relationship
- Build on "DTS" success at Wright-Patterson
- Enhance patient care
- Cost Effective
- Efficient

**AFMS/UPMC (DNA) Enterprise Radiology research**

- Development strategy (Statement of Work)
- Conform need
- Identify and build business rules
- Identify and build AFMS relationships

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**IMITS FY05 - Teleradiology**

**Date:** 10/01/06 – 12/31/08

**Project Manager – Tom Coast**

**Acting Principle Investigator – Carlos Betancourt**

- Over 15 years experience in Clinical and Radiology Informatics
- One of the inventors of the Stentor PACS system

**UPMC / AFMS – Purpose / Focus:**

- Distributed Radiology Dynamic Workload Allocation (DWA) prototype
  - Design, Build, and Test
    - Infrastructure
    - Software / Services
  - Provide
    - Clinically relevant services on a flexible and secure stable technology platform!

**Objectives:**

- Evaluate the utility and use of a DWA infrastructure, software, and services
- Provide AFMS with strong rationale for the adoption of DWA for Radiology

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**DWA - AFMS Radiology Primary Requirements**

- DWA Must Address...**
  - Workload balance
  - Sub-specialty development/consultation
  - Workflow deficiencies
  - Patient care for mobile patient population
  - On-call rotation
  - Contract services
  - Business continuity plan / disaster recovery requirements
  - Clinical image and information exchange
- DWA Will Integrate With...**
  - AFMS Enterprise Radiology Business Model
    - Addresses AFMS Radiology Requirements defined in the RadNet Capability Development Document (CDD)
    - Provides an infrastructure to address developing AFMS Imaging Initiatives
      - NHS Wounded Warrior Initiative

**UPMC IMITS Teleradiology History**

**DTS to DWA**

**2002 - 2004**  
IMITS-02 – Customized, Deployed and Supported UPMC patented Dynamic Transfer of Syntax (DTS) technology at Wright-Patterson AFB

**2005 - 2006**  
AFMS Enterprise contribution not MTF-to-MTF solution  
Build on SGR/UPMC positive relationship  
Build on 'DTS' success at Wright-Patterson  
Enhance patient care  
Cost Effective  
Efficient

AFMS/UPMC (DWA) Enterprise Radiology research  
Development strategy (Statement of Work)  
Confirm need  
Identify and build business rules  
Identify and build AFMS relationships

**2008 - Current**  
IMITS-05 - DWA – Enterprise contribution plan

**UPMC** **DWA - AFMS Radiology**  
**Primary Requirements**

- DWA must address the following
  - Workload balance
  - Sub-specialty development/consultation
  - Workflow deficiencies
  - Patient care for mobile patient population
  - On-call rotation
  - Contract services

**UPMC** **IMITS Center** **DWA Project**

- AFMS Enterprise Radiology Business Model
  - Addresses AFMS Radiology Requirements addressed in the Congressional Proposal and the RadNet Capability Development Document
  - Provides an Infrastructure to address additional AFMS Imaging Initiatives
- IMITS – DWA
  - Funded thru 12/08
  - Four Phase Project
    - Currently in Phase II
  - Four Base Prototype

**UPMC** **IMITS Center** **DWA Project Findings**

- Requirement for DWA (Enterprise Radiology)
- Radiology business rules
- AFMS Support
  - USAF/SGRI Chief of Telehealth collaboration (LtCol. Lacy)
  - AFMS partner relationship required
- Multiple AFMS imaging initiatives
  - IMITS DWA / Radnet / Wounded Warrior / Etc...
- Clinical image and information exchange (SOA/CIIE) value
- Business continuity plan / disaster recovery requirements
- Network infrastructure investigation
  - Phase II prototype testing
- AFMS PACS vendor review

**UPMC IMTs Center**

## DWA Project Status

- Phase I – Completed
  - Report submitted and approved by SGR
- Phase II – Initiated
  - Collaboration with AFMS partner, ICDB Program Office
    - Accreditation
    - CHCS Interface management
    - IDBS – (SOACIE)
  - Prototype Development
    - DWA software
    - Enterprise radiology business model
    - AFMS SOACIE Infrastructure Integration

**UPMC IMTs Center**

## DWA Next Steps

- Phase II
  - Software/Program Development
    - Radiologist collaboration
    - Prototype
    - Phase II Report
- Phase III
  - Phase II Demonstration
  - Security Accreditations
  - Second iteration development
- Phase IV
  - Verify and validate prototype at 4 MTFs

**UPMC IMTs Center**

## DWA Benefits / Summary

- Enterprise Radiology business model development
- AFMS Clinical Image and Information Exchange Foundation
- Financial
  - Reduction in long-term patient care costs
  - Minimizes contract services
  - Increases reimbursement – accurate RVU reporting
  - Leveraging internal AFMS system partners
- Foundation for Wounded Warrior
- Infrastructure for business continuity plan
- PACS strategic management model
- Approval for AFMS Enterprise Radiology Implementation
  - Mechanism for sustainment (Funds/POM)
- Strategic partnership with SAIC/ICDB and the UPMC IMTs Center

**UPMC IMTs Center**

## FY02/FY04 Telepathology Project

**Collaborations**

- UPMC IMTs Center
- UPMC Department of Pathology
- University of Pittsburgh
- USAF (Keesler, Eglin, Travis, Lackland, Offutt, and Nellis AFBs)

**FY02 Accomplishments**

- DoD approved Static Image equipment and software installed
  - Keesler
  - Eglin
  - Travis AFBS
- Whole slide Imaging (WSI) equipment installed at Keesler AFB
- Static Image case reviews initiated between USAF sites and UPMC

**UPMC IMITS Center**

**FY02/FY04 Telepathology Project**

**FY04 Accomplishments**

UPMC conducted a series of validation studies for whole slide imaging (WSI)  
 Quality Assurance – published  
 Primary Diagnosis – published

UPMC challenged market leaders in WSI systems and assessed their capabilities

Static image case reviews continue between USAF sites and UPMC

**UPMC IMITS Center**

**IMITS FY05 - Telepathology**

**Dates: 10/01/06 – 7/31/08**

**Project Manager – Leslie Anthony**

**Principal Investigator – Dr. Drazen Jukic**  
 • UPMC Derm-pathologist and University of Pittsburgh Professor of Pathology  
 • Experience in Telemedicine, Digital Pathology, and WSI

**UPMC / AFMS – Purpose / Focus:**  
 • Continued implementation / evaluation of Telepathology clinical systems / applications  
 • Address the need to improve the level of USAF Telepathology experience, expertise, and adoption

**Objectives:**  
 • Evaluate the utility of advanced Telepathology technology / applications as an alternate means of health care delivery.  
 • Provide AFMS with strong rationale for the adoption of Telepathology methodologies, products, and processes

**UPMC IMITS Center**

**IMITS FY05 - Telepathology**

**Current Status:**

- Digital Pathology Validation / Evaluation Studies
- IRB Approval Processes
- Development of Educational and Referral Library for Pathology – In Process
- Equipment has been purchased – pending USAF Delivery
- Established an USAF Charter for Pathology
- National Presentations
  - Showcase for Commerce
  - ATA
  - APRI

**Next Steps:**

- Deliverable: Robotic Microscopes USAF
- Conduct/Write Evaluation Studies
- Complete Educational and Referral Library
- Approval USAF Charter
- Continue Digital Pathology Development

**Additional Development Opportunities:**

- Zebra Development
- Whole Slide Imaging (WSI) Development
- Open Diamond Integration (ODI)

**UPMC IMITS Center**

**IMITS FY05 - Telepathology**

- A USAF symposium was held in Pittsburgh, Sept 9 – 12, in conjunction with APRI, an international conference focused on pathology informatics
  - USAF and UPMC conducted a pre-conference WSI workshop
  - Joint presentations were included
  - Through a series of meetings, USAF, USAF Telepath and UPMC strategized a plan for telepathology in the USAF and drafted a telepathology charter
  - USAF pathology participation was co-sponsored by AFMS/ASQRS

**12th Annual Conference**  
**APRI 2007**  
**September 9-12, 2007**  
**Marriott City Center**  
**Pittsburgh, Pennsylvania**  
 With a focus on digital pathology  
 in the USAF and military

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**IMITS FY04 - Teleaudiology**

**Date:** 10/01/04 - 12/31/07

**Project Manager – Aaron Yanuzzo**

**Principle Investigator – Catherine Palmer, Ph.D. / Ben Sierra M.D., Col Retired**

- Dr. Palmer is currently the Director of UPMC Audiology and Hearing Aids
- Dr. Sierra is the former USAFWHMC Audiologist and serves as a WHMC Audiologist

**UPMC / AFMS – Purpose / Focus:**

- Design a process to remotely access cochlear implants
- Solve USAF and civilian logistics issue
  - Solve concerns and anomalies related to receiving patient care from non-English speaking providers while stationed overseas

**Objectives:**

- Conduct a feasibility study to evaluate methods to provide safe and accurate remote access to WHMC cochlear implant patients

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**Teleaudiology Primary Requirements**

**Cochlear Implant remote access process must address:**

- Process**
  - Provide remote access cochlear implants from one location
  - Provide user friendly process and training for hearing impaired professionals
- Financial**
  - Reduced civilian and USAF patient costs (PTO, Travel, etc...)
  - Reduced USAF provider costs
  - Increased civilian provider costs
  - Quality of patient care vs. increased costs to provide service
- Logistics**
  - Providing patient care vs. availability of hearing impaired professionals
  - Providing patient care for mobile patient population
  - Providing active duty personnel the ability to return to current active duty assignment/orders regardless of cochlear implant mapping requirements

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**IMITS FY04 - Teleaudiology Project**

**Risks / Complications:**

- Manufactures Participation
  - Cochlear Americas / Advanced Bionics / Med-El
  - Priority – High Tier Two (Financial Investment)
  - FDA Approval Requirements
  - DISCAR/DIRCAP Requirements

**Current Status:**

- Conducted Feasibility Study – Finalizing for SGR submission
- Selected Remote Access Process (Defined – next slide)
- Purchased / Installed Required Equipment
  - VTC Devices
    - USAF – Polycom Mobile Responder (Pending Delivery)
    - UPMC – Polycom MedLink Cart (Installed)
  - Remote Control Software
    - USAF – ConnectWise
    - UPMC – Windows Remote Desktop

**Next Steps:**

- Submit Final Report / Feasibility Study
- FDA Approval – Remote Process
  - Option 1 – Manufacturer Only
  - Option 2 – Secure Continuation Funding
    - Support Investigator Research
    - Support Manufacturer LOS
    - Pending response to SGR BAA white paper submission May '07

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**IMITS FY04 - Teleaudiology Project**

**Cochlear Implant Remote Access Model**

- Remote Mapping Option Client/Server solution

```

graph TD
    Client[Client Computer] --> Server[Server]
    Server --> MedicalDevice((Medical Device))
    Server --> Database[Database]
    Server --> Printer[Printer]
    MedicalDevice --> PatientHead[Patient Head]
  
```

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**IMITS FY04 - Teleaudiology Project Other Usages**

- Medical / Surgical Procedures**
  - Capture an image (picture) of the tympanic membrane and middle ear
    - Diagnosis blast injury exposures
  - Evaluate the post-auricular ear surgical site
  - Conduct pre-op assessments of the physical status of the ear
- Audiology Procedures**
  - Usage on other devices that might be remotely programmed
    - Other implantable hearing devices, traditional programmable hearing aids
  - Usage in other populations / facilities that might be served
    - Native Americans and rural populations
    - VA and nursing homes
- Speech Pathology**

**UPMC IMITS Center**

**IMITS FY04 - Teleophthalmology**

Dates IMITS FY04: 10/01/04 – 12/31/07  
 Dates UPDI FY05: 10/01/05 – 12/31/06

**Principal Investigator – Andrew Eber, M.D.**  
**Project Manager – Leslie Anthony**

**UPMC / APMS – Purpose / Focus:**  

- Help detect and treat diabetic retinopathy

**Purpose:**  

- Develop a modular, mobile image capture and transfer system
- Develop an efficient workflow process for screening for diabetic retinopathy
- Collaborators
  - UPMC IMITS Center
  - University of Pittsburgh Diabetes Institute
  - University of Pittsburgh Department of Biomedical Informatics
  - WVford Hall Medical Center

**UPMC IMITS Center**

**IMITS FY04 - Teleophthalmology - Accomplishments**

- Process**
  - Digital images of the retina are captured with a non-mydriatic fundus camera –
    - Note: no dilation is required
  - Medical information and retinal images are 'packaged' and transferred
  - Specialist uses customized software to grade the images
  - Results and recommendations for care are sent to the patient
    - Over 700 people with diabetes were screened for diabetic retinopathy
      - 88% had Type 2 diabetes
      - 2% had serious eye disease
      - 51% had their last eye examination over a year ago
- Next Steps**
  - Continuation of retinal screening software to integrate with PACS/RIS systems
  - Training diabetic educators on how to image
    - Link educational sessions with retinal screenings
  - Recruit health plans - target people with diabetes not receiving proper eye care
  - Promote retinal screenings in the consumer market place to maximize outreach
    - Such as: Pearl Vision, Wal-Mart

**UPMC IMITS Center**

**IMITS FY04 - Teleophthalmology**

- Installed stationary equipment located in healthcare clinics will promote retinal screenings for people at highest risk for diabetic retinopathy
- Provided portable equipment transported to community events will enable retinal screenings for people in areas with poor access to eye care






**Reading Software**





**UPMC IMITS Center**

**IMITS FY04 – Platelet Gel**

Dates IMITS FY04: 10/01/04 – 12/31/07  
 Dates UPDI FY05: 10/01/05 – 12/31/08

Principal Investigator – David Steed, M.D.  
 Project Manager – Aaron Yanuzo

UPMC / AFMS – Purpose / Focus:

- Conduct multi-center, randomized, controlled study
  - Provide evidence sufficient to demonstrate the safety and efficacy of Autologous PG Therapy on non-healing diabetic foot wounds
  - Randomization on a 1:1 basis
    - Standard (control arm)
      - Wet/dry dressing
      - Debridement of wound to necrosis-free state, using sharp instrument
      - Application of Hydrogel
      - Closure of wound with Allevyn
    - Autologous PG (treatment arm)
      - Standard treatment as described above – except Hydrogel will be replaced by Autologous PG
      - Phlebotomy will be performed in order to produce the Autologous PG and Autologous Thrombin

**UPMC IMITS Center**

**FDA (IND/IDE) and IRB Process Overview**

**Accomplishments**

- Research Protocol Design
  - Pilot Study Protocol Development
    - Single or Multi-centered Comparative Study
    - Civilian / Military / Civilian and DoD (WHMC Participation?)
    - Coordinating Center Requirements - TID
    - Patient Enrollment/Recruitment
  - Project Management
- FDA Approval Process
  - IDE Investigator Sponsored Studies
    - Using FDA-Approved Devices in a non-FDA Approved Application
    - Using second non-FDA Approved Device (Autologous Thrombin)
    - Full FDA Review/Expedited process
    - Non PMA or 510k approval requirements (manufacture's responsibility)
    - Pre-submission meetings / Protocol submission
    - Class C approval / non-approval meetings
    - Conditional approval (Follow-up amendment – December 2007)

**Next Steps**

- IRB/IR Approval Process
  - University/Pittsburgh Approval Process – 1st Quarter 2008
  - DoD / USAF / US Army Approval Process (WHMC Participation?) – Second Quarter 2008
  - DoD Second Level Approval Process – Second Quarter 2008
  - Implementation of the Pilot Study – Third Quarter 2008

**UPMC IMITS Center**

**IMITS FY04 – Nursing Simulation**

Dates IMITS FY04: 10/01/04 – 12/31/07  
 Project Manager – Aaron Yanuzo  
 Principal Investigator – Judy Bradie and Dr. John O'Donnell

UPMC / AFMS – Purpose / Focus:

- Provide an innovative simulation training protocol that simulate patient move scenarios
- Objectives:
  - Nursing staff efficiencies for transferring a patient
    - Patient recovery process will be accelerated
    - Patient injury as a result of transfer related events will be reduced
    - Patient satisfaction improves
  - Incorporate simulation training techniques to address the following
    - Transferring patient weighing 75 – 300 lbs to and from a Chair or Bed or one person to and from wheelchair or bedside commode to a bed
    - Lifting a "non-use of legs" patient weighing 75 – 175 lbs by two staff members from a wheelchair to a bed
    - Making a bed with the patient in place

**UPMC IMITS Center**

**IMITS FY04 – Nursing Simulation**

Current Status:  
 • Completed Project

**Accomplishments:**

- Completed 10 point protocol for patient lifting
- Conducted a pilot research study at UPMC / WISER with positive results for UPMC
- Published result of the pilot study
- Presented the results at national conventions
  - ATA
  - SSRN
- Presented final report to DGR for review
- UPMC will incorporate into the standard UPMC training requirements

**Next Steps:**

- Transition curriculum into an UPMC institutional training program
  - Offered to all UPMC employees where patient lifting is required
  - Offered as an external medical training course to non-UPMC medical professionals (AFMEN)
- Investigate other potential deployment of this curriculum to DoD medical organizations
  - Military (USAF – Air Education and Training Command (AETC)) / VA / Indian Health
- Investigate other potential funding sources
  - Continuation / expansion of the nursing curriculum collaboration between UPMC, University of Pittsburgh (WISER), and the USAF

**UPMC**  
IMTS Center

**IMITS FY04 – WHMC Simulation**

**Dates:** IMITS FY04: 10/01/04 – 12/31/07

**Project Manager – John Mechiel**

**Principle Investigator – Dr. Paul Phrampus**

- UPMC Emergency Medicine Physician and University of Pittsburgh Professor
- Director of the WISER Institute of Simulation – University of Pittsburgh

**UPMC / AFMS – Purpose / Focus:**

- Determine if incorporating a simulation training program into WHMC existing conventional training program would provide the readiness skills required to prepare military staffing for deployment.

**Objectives:**

- Conduct a WHMC simulation training (readiness skills) "Needs Analysis"
  - Increase the competencies of military staffing
  - Reduce the time and expense of training military staffing
  - Evaluate the effectiveness of exporting this technology to off-site locations.
  - Evaluate providing distance educational training

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**IMITS FY04 – WHMC Simulation**

**Current Status:**

- Completed Project

**Accomplishments:**

- Completed "Readiness Assessment" and submitted to GGR
- Established a WHMC Simulation Center
  - Equipment was procured through IMITS FY04 funding and DoD funding at WHMC
  - Curriculum was developed through a collaborative effort between UPMC, University of Pittsburgh (WISER), and WHMC
    - Readiness
    - Medical Response
    - Medical Education
  - Student enrollment has reached 400 encounters/month and over 2,000 encounters since 2006
  - Simulation Center will be expanded to 3,000 sqft. in late November/December 2007

**Next Steps:**

- Expand of the newly formed simulation center
  - UPMC project to expand the Center of Simulation (WHMC)
  - Contract staffing of the simulation center with civilian personnel
- Continue to develop simulation education in conjunction with UPMC, WISER, & USAF
- Investigate other potential funding sources
  - WHMC Simuludes Center of Excellence
  - Continuation / expansion of the collaboration
  - UPMC, University of Pittsburgh (WISER), WHMC / USAF and/or other potential institutions
- Investigate other potential needs and funding sources for the systems integration
  - WISER SMS education delivery software system

**UPMC**  
IMTS Center

**IMITS FY04 – University of Hawaii**

**Dates:** IMITS FY04: 10/01/04 – 12/31/07

**Project Manager – Aaron Yamato**

**Principle Investigator – Dr. Paul Phrampus**

**UPMC / AFMS – Purpose / Focus:**

- Establish a partnership between UPMC / WISER and the University of Hawaii
  - Establish a Simulation Center at the University of Hawaii
  - Provide advanced medical education using simulation to Hawaii
  - Beneficial to both institutions and the DoD
    - UPMC / WISER's expertise and existing curriculum
    - WISER expansion in the Asia / Pacific Rim (governmental and international organizations)
  - Develop a process to utilize broadband connectivity to leverage existing faculty at both sites to deliver education, which can reduce the need and cost to have standing faculty at each site

**UPMC**  
IMTS Center

**IMITS FY04 – University of Hawaii**

**Current Status:**

- Completed Project

**Accomplishments:**

- Completed WISER/SMS - SimTid Website
  - Developed the remotely hosted website at the University of Pittsburgh
  - Ported several University of Hawaii manual simulation classes to the web-based delivery edition
- Opened the University of Hawaii / SimTid Medical Simulation Center
  - Began web-based delivery of simulation and non-simulation based education via the SimTid web-site
  - Created the ability share educational resources (profession/instruction)
- Exposed UPMC/University of Pittsburgh/WISER to the Pacific Rim
  - Participated in several Asia Pacific Military Medicine Conferences
  - Created several opportunities for potential collaborative efforts in the Asia / Pacific Rim
  - Submitted final report to GGR for review

**Next Steps:**

- Continue to develop simulation education in conjunction with UPMC, WISER and the University of Hawaii
- Continue to host and refine the SimTid website from the WISER
- Investigate other potential funding sources for the University of Hawaii simulation collaborative efforts
- Investigate other potential funding sources for remotely hosted (ASP) versions of the WISER SMS education delivery software system for the DoD

## **Appendix 4: 2008 ATA Abstract and Presentation: Programming – DWA Routing Engine and Intelligent Algorithms**

1 Rasu B. Shrestha, MD, MBA, 2 Aaron C. Yanuzo, BS, MBA, 1 Carlos Betancourt, BS, 2 Goran Momiroski, BS, MS, 1 Thomas H. Coast, BS, 1 Shawn Moroney, BS, 1 James Mason, BS, 3 Steve Livingston, BS 4

*1UPMC - Innovative Medical and Information Technologies Center (IMITS), Pittsburgh, PA; 2UPMC, Pittsburgh, PA;; 3USAF - Wilford Hall Medical Center, San Antonio, TX; 4SAIC - ICDB, San Antonio, TX*

The Distributed Radiology Dynamic Workload Allocation (DRDWA) system must effectively route radiological exams according to a multitude of criteria. An intelligent rules and routing engine is being developed by the UPMC Innovative Medical and Information Technology Center (IMITS) for dynamic routing of images throughout the Air Force Medical Service (AFMS). Each medical facility contained in the AFMS is ranked according to site availability, Radiologist staff, specialties, and throughput statistics. Each radiological exam contains a specific set of data, which can be interpreted by the rules and routing engine. Through a master command panel, administrators will be able to set preferences for each participating facility on a daily or weekly basis. Each preference will ultimately determine the optimal location for each exam to be diagnostically interpreted. This prototype solution routing algorithms will result in increased productivity and enhanced patient care across the AFMS regardless of AFMS physician staffing constraints, AFMS systems capabilities and patient location.

**UPMC**  
**IMITS**  
 Innovative Medical and Information Technologies

**Distributed Radiology Dynamic Workload Allocation (DRDWA)**  
 A Collaborative Effort with the United States Air Force

April 7, 2008

**UPMC** **2007-Pres IMITS Center**

- Incorporated as Wholly Owned Non-Profit Subsidiary
- Continual growth and funding, establishing new research programs
- Researcher and Physician Leaders/Advisors
- Program and Process Management / PMP / Accounting and Finance Expertise
- Experience in Government Contracts, Government Contractors, Software Development, System Architecture, Industrial Engineering, Private, Academic and Non-Profit sectors, Healthcare, medical products, and Military

**UPMC** **IMITS Center** **DoD Programs Overview**

- UPMC Innovative Medical and Information Technologies (IMITS) Center
  - UPMC & DoD Congressional Research Projects
    - USAF, Army, Navy, and National Guard
  - Multiple UPMC Telemedicine Projects
    - Education
    - Evaluation
    - Extra Corporal Membrane Oxygenation
    - Pediatric Tele-Echo
    - Platelet Gel Therapy
    - Simulation and Training
    - Teleaudiology
    - Telemental Health
    - Teleophthalmology
    - Telepathology
    - Teleradiology

**UPMC** **IMITS Center** **DRDWA - AFMS Radiology Primary Requirements**

- DRDWA addresses the following
  - Workload balance
  - Sub-specialty development/consultation
  - Workflow deficiencies
  - Patient care for mobile patient population
  - On-call rotation
  - Contract services
    - Traditional Teleradiology

**UPMC IMITS Center**

## Principal Investigator

- Rasu B. Shrestha MD MBA**
  - Medical Director, Radiology Informatics, University of Pittsburgh Medical Center (2007 – Present)
  - Informatics Director, Department of Radiology, University of Southern California (2001-2007)
  - Dr Shrestha has extensive knowledge of medical informatics and the business of healthcare.
  - Dr Shrestha was also Professor of Radiology Research at the Keck School of Medicine and has a unique blend of clinical as well as research skills in Medical Informatics
  - Dr Shrestha has proven expertise in driving leading process improvement and major enterprise informatics implementations including PACS (Picture Archiving and Communication Systems), RIS (Radiology Informatics System), EMR (Electronic Medical Records), and Voice Recognition.

**UPMC IMITS Center**

## DRDWA Project

- AFMS Enterprise Radiology Business Model**
  - RadNet
  - Infrastructure to address AFMS Imaging Initiatives
    - Pathology, Ophthalmology, Cardiology, etc.
  - Pending Congressional Proposal for Enterprise Imaging (CABMED)
- IMITS – DRDWA**
  - Currently Funded thru 12/08
    - Possible extension to 12/09
  - Four Phase Project
    - Currently in Phase II
  - Four Medical Treatment Facilities (MTFs) Prototype

**UPMC IMITS Center**

## DRDWA Project Status

- Phase I – Completed**
  - Radiology business rules
  - AFMS Support
    - USAF/BGR Chief of Telehealth collaboration (LtCol. Lacy)
      - RadNet - USAF
    - AFMS partner relationship required
  - Multiple AFMS imaging initiatives
    - IMITS DRDWA / Radnet / Wounded Warrior / Etc...
  - Clinical Enterprise Imaging
    - Developed in Service Oriented Architecture (SOA)
  - Business continuity plan / disaster recovery requirements
  - AFMS PACS vendor review
    - Integration planning between Agfa, Fuji, Phillips, & GE

**UPMC IMITS Center**

## DRDWA Project Status

- Phase II – In Process**
  - Collaboration with AFMS partner, ICDB Program Office
    - CHCS two way Interface management
    - IDIS – (SOA/CIE)
    - Network Infrastructure Investigation
  - Core Software/Program Development
    - Radiologist collaboration (UPMC / USAF)
      - IntraOp Prototype Demonstration
        - Two Base Image Exchange – (TBD)
  - Prototype Development
    - DWA software
    - Intelligent Image Routing Engine
    - Enterprise radiology business model
    - AFMS SOA/CIE Infrastructure Integration

- **Phase III**
  - Collect additional functionality requirements
  - Second iteration development
- **Phase IV**
  - Verify, validate, and test prototype at 4 MTFs
    - 4 MTF DRDWA Routing and Image Exchange
    - Wright-Patterson AFB (Fuji)
    - Dover AFB (Agfa)
    - MacDill AFB (Agfa)
    - Scott AFB (Agfa)
  - Investigate Information Assurance (AI) Accreditations
    - MAJCOM (ATTI/ATO/ATC certification for testing and production implementation
    - DIACAP certification

- DRDWA software
- Intelligent Image Routing Engine
- Enterprise radiology business model
- AFMS SOA/CIIe infrastructure integration
- UPMC Interoperability
  - Strategic Business Model
    - Text
    - Imaging

The diagram illustrates the UPMC Interoperability architecture, specifically the IMITS/AFMS Partner Collaboration framework. It features a central **Management Monitoring** block connected to various components arranged in a grid:

- Network:** Includes **Switches** and **Routers**.
- Security:** Includes **Firewalls** and **Encryption**.
- Business:** Includes **CRM** and **ERP**.
- Application:** Includes **Web Services** and **Business Process Services**.
- Infrastructure:** Includes **Storage** and **Network**.
- Facility:** Includes **Building** and **Facility**.

Arrows indicate the flow of data and control between these components, such as from **Switches** to **Firewalls** and **Encryption**, and from **Management Monitoring** to all other components.

- Enterprise Radiology business model development
- AFMS Clinical Image and Information Exchange Foundation
- Financial
  - Reduction in long-term patient care costs
  - Minimizes contract services
  - Increases reimbursement – accurate RVU reporting
  - Leveraging internal AFMS system partners
- Foundation for Wounded Warrior
  - Image exchange between active duty MTF and Veterans Affairs (VA)
- Infrastructure for business continuity plan
- Approval for AFMS Enterprise Radiology Implementation
  - Mechanism for sustainment (Funds/PCM)
- Strategic partnership with ICDB and the UPMC IMITs Center

## **Appendix 5: 2008 ATA Abstract and Presentation: Evaluating Feasibility of DWA for AFMS**

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Because of the growing need of patient services and the desire to improve radiology practices within the Air Force Medical Service (AFMS), a Distributed Radiology Dynamic Workload Allocation (DRDWA) system has been developed by the UPMC Innovative Medical and Information Technology (IMITS) group. The DRDWA algorithmically distributes radiology cases throughout the AFMS equally – depending on radiologist availability, modality type, and location. In order to determine the feasibility, effectiveness, and utility of the DRDWA, IMITS has contracted the Evaluation Team from the University of Pittsburgh, Department of Biomedical Informatics to conduct rigorous assessments. There are three phases to the evaluation project. The first phase consists of qualitative questionnaires that record the perceptions, attitudes, and experiences of DRDWA programmers, radiologists, and support personnel. The second phase is based on the testing of the DRDWA. Baseline radiology statistics will be collected prior to and after the implementation of the DRDWA and consist of, but are not limited to the following: number of cases read per day per radiologist, preferred modality types, and workload limits and restrictions. Phase three of the project will consist of questionnaires that monitor final perceptions and attitudes of the AFMS users and support personnel. The Evaluation Team has begun to collect data. DRDWA programmers have completed questionnaires, and those results have been analyzed. One of the major goals is to improve workflow and communication between developers and AFMS key personnel. The Evaluation Team can use the feedback from completed questionnaires to obtain this goal. Current results will be reported. If the DRDWA proves to be an effective workload allocation tool, not only will patient care improve throughout the AFMS, but radiologists will be able to strengthen their practice by increasing their knowledge in subspecialty experiences. Results from completed phases will be discussed.



## Evaluation Team

Evaluating the Feasibility of a Distributed Dynamic Workload Allocation System With the Air Force Medical Service

## Authors

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## Background



- Through appropriations in the defense-spending bills for 2002 and 2004, the University of Pittsburgh Medical Center (UPMC) and the United States Air Force Medical Service (AFMS) created a partnership called the Integrated Medical Information Technology System (IMITS) Program
- Teleradiology is a branch of the IMITS program that is focusing on a solution to distribute radiology cases system wide within the Air Force



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## Introduction

- The Dynamic Radiology Distributed Workload Allocation (DRDWA) is a radiology solution that will allocate workloads throughout the AFMS based on several variables
  - Radiologist Availability
  - Modality
  - Historical Site Performance
  - Subspecialty



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## Purpose of Evaluation Research

To examine questions related to:

- Technical validity
  - Do the components of the DRDWA do what is intended
  - Is it accurate and reliable
- Feasibility
  - Is it fast enough
  - Is it user friendly
- Effectiveness
  - Does it improve user's efficiency
  - Does it improve patient care

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## Evaluation Goals

- Determine the effectiveness and feasibility of a distributed workload system
  - Does it properly distribute radiology cases
  - Turn around time
  - Radiologist satisfaction
  - Workflow implementation factors

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## Methods

- Three phases to the Evaluation Team's plan
  1. Pre-DRDWA Implementation
  2. DRDWA Implementation
  3. Post-DRDWA Implementation

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## Pre-DRDWA Implementation

- Work flow analysis
  - Observations of radiology workflow patterns
  - Includes radiologists, clinicians, technicians, and other support personnel
  - Track radiology work-up through seven phases

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## Pre-DRDWA Implementation

- Interviews/Questionnaires
  - Radiologists
  - DRDWA Developers
  - Radiology Support Personnel



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## Pre-DRDWA Implementation

- Radiology Statistics
  - Cases examined per year per modality, teleradiology cases encountered, turn-around time
  - Radiology Performance



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## DRDWA Implementation

- DRDWA Performance Variables
  - Number of cases reallocated
  - Turn-around times
  - Length of queues at each base
  - Subspecialty exposure
- Required Training
- Workflow Changes



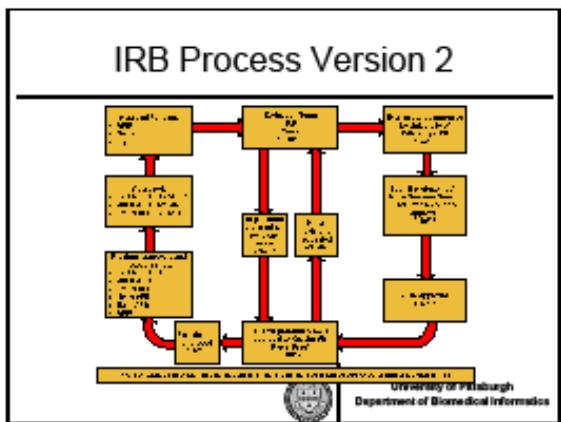
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## Post-DRDWA Implementation

- Questionnaires/Interviews with all relevant personnel



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